DESCRIPTION

(as originally filed)

GRINDING PROCESS AND APPARATUS

FIELD OF THE INVENTION

The present invention relates to an improvement in grinding process and apparatus for grinding a peripheral surface of a rotated work by a rotary grindstone rotated by a wheel spindle.

BACKGROUND ART

Such a grinding apparatus is already known, as disclosed, for example, in Patent Document 1.

[Patent Document 1]

Japanese Patent Application Laid-open No.9-300193

A grinding flash and a grinding trace remain on a work ground by a rotary grindstone. Therefore, it is a conventional practice that the ground work is subjected to a treatment in an exclusive deflashing device and an exclusive polishing device, where the removal of a ground flash and the polishing of a ground surface are carried out. In such a method, however, a lot of labor is required for shifting the work from the grinding apparatus to the deflashing device or the polishing device, and, an equipment cost is high due to the need for the exclusive deflashing and polishing devices. For this reason, it is difficult to reduce the work-grinding cost.

DISCLOSURE OF THE INVENTION

Accordingly, the present invention has been accomplished in view of the above circumstances, and it is an object of the

present invention to provide grinding process and apparatus, wherein the removal of a ground flash and the polishing of a ground surface can be conducted subsequently to the grinding of a work, whereby the shifting of the work and the exclusive deflashing and polishing devices are not required, which can contribute to a reduction in machining cost.

To achieve the above object, according to a first aspect and feature of the present invention, there is provided a process for grinding a peripheral surface of a rotated work by a rotary grindstone rotated by a wheel spindle, characterized in that the process comprises the steps of mounting a rotary brush to one side of the rotary grindstone so as to be rotated along with the rotary grindstone, grinding the work by the rotary grindstone and then moving the rotary grindstone and the work axially relative to each other, and brushing a ground surface of the work by the rotary brush, thereby polishing the ground surface of the work.

With the first feature, when the rotary grindstone and the work are moved axially relative to each other subsequently to the grinding of the work by the rotary grindstone, and the ground surface of the work is brushed by the rotary brush, the polishing of the ground surface can be achieved. In this manner, the grinding and the polishing can be carried out continuously and hence, the detachment of the work is not required between these treatments. Therefore, it is possible to remarkably shorten the machining time, as compared with the conventional

case where a polishing step is provided specially. This can contribute to a reduction in machining cost in cooperation with that an exclusive polishing device as used in the prior art is not required either.

According to a second aspect and feature of the present invention, there is provided a process for grinding a peripheral surface of a rotated work by a rotary grindstone rotated by a wheel spindle, characterized in that the process comprises the steps of mounting a rotary brush to one side of the rotary grindstone so as to be rotated along with the rotary grindstone, grinding the work by the rotary grindstone and then moving the rotary grindstone and the work axially relative to each other, and brushing end edges of a ground surface of the work by the rotary brush, thereby removing a ground flash of the work.

With the second feature, when the rotary grindstone and the work are moved axially relative to each other subsequently to the grinding of the work by the rotary grindstone, and the end edges of the ground surface of the work are brushed by the rotary brush, the removal of a ground flash can be achieved. In this manner, the grinding and the polishing can be carried out continuously and hence, the detachment of the work is not required between these treatments. Therefore, it is possible to remarkably shorten the machining time, as compared with the conventional case where a deflashing step is provided specially. This can contribute to a reduction in machining cost in

cooperation with that an exclusive deflashing device and an exclusive polishing device as used in the prior art are not required either.

According to a fourth aspect and feature of the present invention, there is provided a grinding apparatus including a rotary grindstone mounted to a wheel spindle to grind a work by the rotation of the rotary grindstone, characterized in that a rotary brush is mounted adjacent to the rotary grindstone for brushing the work having a diameter larger than that of the rotary grindstone and ground by the rotary grindstone.

With the fourth feature, the removal of a ground flash and the polishing of a ground surface of the work can be achieved reliably by the brushing using the rotary brush by only moving the rotary grindstone and the work axially relative to each other subsequently to the grinding of the work by the rotary grindstone. The detachment of the work is not required between these treatments and hence, it is possible to remarkably shorten the machining time. This can contribute to a reduction in machining cost in cooperation with that an exclusive deflashing device and an exclusive polishing device are not required either.

According to a fifth aspect and feature of the present invention, in addition to the fourth feature, the rotary brush is formed into a variable-diameter type, so that when the wheel spindle is rotated at a low speed lower than a grinding rotational speed of the rotary grindstone, the diameter of the rotary brush is smaller than that of the rotary grindstone, but when the wheel

the camshaft 10, data E of phase difference between the cams 10a, 10b --- 10n as well as data S of axial distances between the cams 10a, 10b --- 10n. The NC control unit controls the operations of the first to fourth electric motors 8, 14, 18 and 31 based on these signal and data.

The standard phase sensor 35 is mounted at a tip end of a sensor-supporting arm 37 pivotally supported on the wheel spindle stock 20. The sensor-mounting arm 37 is capable of being swung between a detecting position A in which the standard phase sensor 35 is opposed to the outer peripheral surface of the outermost cam 10a closest to the head stock 5 and a resting position B in which the sensor 35 is spaced apart from the camshaft 10. An electromagnetic or electric actuator 38 is connected to the sensor-supporting arm 37 for swinging the sensor-supporting arm 37 between the two positions A and B.

When the cam 10a has been rotated from the base circle portion 50 toward the cam lobe 51 relative to the standard phase sensor 35, the standard phase sensor 35 detects a predetermined lift amount of the cam 10a between the base circle portion 50 and the cam lobe 51, and the detection signal of the standard phase sensor 35 is input as a signal indicative of the standard phase of the cam 10a to the NC control unit 33. The type of standard phase sensor 35, which can be used, may be any of a non-contact type and a contact type.

As shown in Figs.3 and 4, a rotary brush 40 is mounted to the wheel spindle 21 adjacent the rotary grindstone 22. The

WHAT IS CLAIMED IS

1. A process for grinding a peripheral surface of a rotated work (10) by a rotary grindstone (22) rotated by a wheel spindle (21),

characterized in that said process comprises the steps of mounting a rotary brush (40) to one side of said rotary grindstone (22) so as to be rotated along with said rotary grindstone (22), grinding said work (10) by said rotary grindstone (22) and then moving said rotary grindstone (22) and said work (10) axially relative to each other, and brushing a ground surface of said work (10) by said rotary brush (40), thereby polishing the ground surface of said work (10).

2. A process for grinding a peripheral surface of a rotated work (10) by a rotary grindstone (22) rotated by a wheel spindle (21),

characterized in that said process comprises the steps of mounting a rotary brush (40) to one side of said rotary grindstone (22) so as to be rotated along with said rotary grindstone (22), grinding said work (10) by said rotary grindstone (22) and then moving said rotary grindstone (22) and said work (10) axially relative to each other, and brushing end edges of a ground surface of said work (10) by said rotary brush (40), thereby removing a ground flash of said work (10).

3. A process for grinding a peripheral surface of a rotated work (10) by a rotary grindstone (22) rotated by a wheel spindle

(21),

characterized in that said process comprises the steps of mounting a rotary brush (40) to one side of said rotary grindstone (22) so as to be rotated along with said rotary grindstone (22), grinding said work (10) by said rotary grindstone (22) and then moving said rotary grindstone (22) and said work (10) axially relative to each other, and brushing the entire ground surface of said work (10) from end edges of the ground surface by said rotary brush (40), thereby achieving the removal of a ground flash of said work (10) and the polishing of the ground surface.

4. A grinding apparatus including a rotary grindstone (22) mounted to a wheel spindle (21) to grind a work (10) by the rotation of the rotary grindstone (22),

characterized in that a rotary brush (40) is mounted adjacent to said rotary grindstone (22) for brushing the work (10) having a diameter larger than that of said rotary grindstone (22) and ground by said rotary grindstone (22).

5. A grinding apparatus according to claim 4, wherein

said rotary brush (40) is formed into a variable-diameter type, so that when said wheel spindle (21) is rotated at a low speed lower than a grinding rotational speed of said rotary grindstone (22), the diameter of said rotary brush (40) is smaller than that of said rotary grindstone (22), but when said wheel spindle (21) is rotated at a speed equal to said grinding